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A SURVEY OF NINE KENTUCKY COUNTIES FOR AIR POLLUTION EFFECTS ON VEGETATION

By

William Sites, Mark Matuszewski, and Robert Loomis

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ABSTRACT

During June, July, and August of 1974, surveys were conducted in six areas (involving nine counties) in the Commonwealth of Kentucky. Each area was selected on the basis of the type of industry located there and the composition of the emissions commonly associated with it. Several types of vegetation were examined for a radius of five miles from each source. No evidence was found to indicate that phytotoxic emissions had been released during the current growing season up to the date of each survey.

INTRODUCTION

Air pollution is a disease causing agent. Some of the effects can be quite dramatic--discolored foliage, tree and shrub mortality. Other effects, such as minute reductions in growth and shifts in plant populations, are less dramatic and difficult to measure.

Field observations of vegetation affected by phytotoxic emissions can illustrate several things. First, a perimeter around the affected area can be delineated from expressed symptoms. Secondly, a general

1/ Plant Pathologist, Forest Pest Management, Southeastern Area, S&PF, Asheville, N.C. 28803; Forest Insect and Disease Specialist, Department for Natural Resources and Environmental Protection, Division of Forestry, Frankfort, Ky. 40601; and Plant Pathologist, Forest Pest Management, SEA, S&PF, Atlanta, Ga. 30309, respectively.

estimate of the time lapse between the fumigation and the inspection can be made by an experienced person. In addition, increases in tree mortality can be monitored during recurring surveys.

METHODS

The areas were selected from a compilation of sources with a high potential output of sulfur dioxide (SO_2), fluorides, chemical plant emissions, or areas likely to suffer from photochemical smog.[2/] Sources of SO_2 were confined to coal burning electric generating plants with emission level estimates based on electrical output rating. In the case of fluorides, the area selected contained several aluminum plants. One area with potential for photochemical production of oxidants was selected. Several chemical plant site locations were also examined.

The vicinity around three electric generating plants was surveyed. They were the TVA facilities at Paradise, the Shawnee Plant west of Paducah, and the John Sherman Cooper Power Station near Burnside. The survey for fluorides was centered in Hawesville, while Calvert City was checked for symptoms for photochemical smog and Ashland for the effects from chemical plant emissions.

In each area the source was placed at the center with a 5-mile radius extending in all directions. Exceptions to this 10-mile wide circular plot occurred at the Shawnee Plant, Paducah; the Hawesville and Ashland areas. In these cases only the Kentucky side of the Ohio River was surveyed, since none of the participants held jurisdiction in Illinois, Indiana, or West Virginia.

Within the radius of the survey, roadside inspections of trees and associated vegetation were made to determine if phytotoxic materials had been released during the current growing season. Species known to be sensitive to particular pollutants were used as indicators of air pollution effects. These included blackjack oak, loblolly pine saplings for SO_2 and redbud for fluoride (Jacobson and Hill, 1970).

Where any positive symptoms were observed, data sheets were available to indicate the severity of the symptoms within the species population and the severity per affected individual (Fig. 1). In addition, positive observations, where they might have occurred, were to be located and marked on the map.

The maps used in the survey were topographic maps--assembled to provide

2/ The list was compiled with the cooperation of Mr. John T. Smither, Director, and Mr. Miles M. Smith, Chief, Special Assignment Section, Dept. for Natural Resources and Environmental Protection, Division of Air Pollution, Commonwealth of Kentucky, Frankfort, Ky. 40601.

DETECTION SURVEY - AIR POLLUTION EFFECTS

State_____
County_____
Source_____
Date_____
Examiner_____

Distance From Source_____
Direction From Source_____

PLOT NUMBER_____

Plant Species	Uninjured Total	Injured Total	Effects* Rating	Sample No.	Roll Number	&Photo Number	Remarks

* 5/1 5 = Actual Percent Plants With Symptoms - If More Than 20 Estimate Percent
1 = Estimated Average Leaf Symptom Class

∠ 5%	= 1
6-20%	= 2
21-50%	= 3
51-100%	= 4

Figure 1. Sample data sheet used to record air pollution effects to vegetation.

complete coverage of the area under study. To the extent permitted by the available road system, an ever widening circular pattern was followed from a starting point at the source. This system was followed to a maximum radius of five miles or, as in some cases, the Commonwealth boundary.

RESULTS

Careful observations within each of the six selected areas revealed no noticeable symptoms. Relevant information regarding each survey is summarized in Table 1. Variations in the acreage of the six areas reflect the nearness of some to the Commonwealth boundary.

DISCUSSION

These surveys were conducted to (1) identify areas which may be affected by air pollution, and (2) to evaluate forest and tree conditions in the vicinity of a representative number of these areas. In Kentucky, the survey areas were ultimately chosen for the industries located there and their potential to cause injury to the surrounding vegetation. This, however, should not be interpreted to mean that local industry had necessarily caused injury in the past or that they were suspected of releasing phytotoxic emissions. Conversely, the lack of symptoms at the time of the survey does not mean that injury cannot occur in the future. No attempt was made to monitor air quality from any of these sources prior to or during the survey.

The results indicate that either no phytotoxic substances were released in the spring or summer of 1974 up to the date of the survey, or the dosage was small enough not to induce symptom development. This is due to the fact that no consistent or definitive pattern of symptoms was observed by species or by geographic location within any of the survey areas.

The most definite conclusions rendered by this survey are that forest vegetation in the areas examined appeared normal and that no projections can be made regarding future injuries. Observations made on the date of the survey are historical reflections. For example, an observation of no injury means simply that, as of that date, emission levels and/or environmental conditions were absent or phased properly to result in no visible injury. Since these conditions are essentially unknown, in the future any combination is possible that may result in symptom expression

Table 1. Tabulation of surveys showing acreages and indicator species examined.

Survey Number	Area	Counties	Date of Survey	Potential Emission and Source	Acreage	Species Examined
1	Paradise	Muhlenberg, Ohio	June 4, 1974	SO_2-Paradise	20,266	Blackberry (Rubus sp.) Giant Ragweed (Ambrosia trifida) Lesser Ragweed (Ambrosia artemisiifolia) Redbud (Cercis canadensis) Red Clover (Trifolium pratense) Sassafras (Sassafras albidum) Virginia Pine (Pinus virginiana)
2	Hawesville	Hancock	June 5, 1974	FL - From Aluminum Plants	33,175	Box Elder (Acer negundo) Greenbrier (Similax sp.) Honey Locust (Gleditsia tricanthos) Pine Oak (Quercus palustris) Polk Weed (Phytolacca americana) Redbud (Cercis canadensis) Red Clover (Trifolium pratense) Virginia Pine (Pinus virginiana) Wild Cherry (Prunus serotina) Wild Grape (Vitis sp.)
3	West of Paducah	McCracken	July 15, 1974	SO_2-Shawnee Power Plant	25,133	Blackberry (Rubus sp.) Carolina Cranesbill (Geranium carolinianum) Giant Ragweed (Ambrosia trifida) Lesser Ragweed (Ambrosia artemisiifolia) Pennsylvania Smartweed (Polygonum pennsylvanicum) Redbud (Cercis canadensis) Virginia Pine (Pinus virginiana)
4	Calvert City	Livingston, Marshall	July 17, 1974	Photochemical	50,266	Blackberry (Rubus sp.) Eastern Redcedar (Juniperus virginiana) Giant Ragweed (Ambrosia trifida) Lambs Quarters (Chenopodium album) Lesser Ragweed (Ambrosia artemisiifolia) Pennsylvania Smartweed (Polygonum pennsylvanicum) Redbud (Cercis canadensis) Red Clover (Trifolium pratense) Smooth Sumac (Rhus glabra) Soybean (Glycine max) Virginia Pine (Pinus virginiana)

Table 1 Cont'd.

Survey Number	Area	Counties	Date of Survey	Potential Emission and Source	Acreage	Species Examined
5	Ashland	Boyd, Greenup	July 23, 1974	Chemical Plants	25,133	American Elm (Ulmus americana) Ash (Fraxinus sp.) Beech (Fagus sp.) Blackberry (Rubus sp.) Giant Ragweed (Ambrosia trifida) Greenbrier (Similax sp.) Hickory (Carya sp.) Lesser Ragweed (Ambrosia artemisiifolia) Poison Ivy (Rhus toxicodendron) Redbud (Cercis canadensis) Red Clover (Trifolium pratense) Red Maple (Acer rubrum) River Birch (Betula nigra) Sassafras (Sassafras albidum) Smooth Sumac (Rhus glabra) Sycamore (Platanus occidentalis) White Pine (Pinus strobus) White Grape (Vitis sp.) Winged Sumac (Rhus copallina) Yellow Poplar (Liriodendron tulipifera) Virginia Pine (Pinus virginiana)
6	Burnside	Pulaski	Aug. 6, 1974	SO_2- John Sherman Cooper Power Station	50,266	Ash (Fraxinus sp.) Blackberry (Rubus sp.) Dogwood (Cornus florida) Elm (Ulmus sp.) Giant Ragweed (Ambrosia trifida) Lesser Ragweed (Ambrosia artemisiifolia) Northern Red Oak (Quercus rubra) Pennsylvania Smartweed (Polygonum pennsylvanicum) Post Oak (Quercus stellata) Redbud (Cercis canadensis) Southern Red Oak (Quercus falcata) Virginia Pine (Pinus virginiana) Wild Grape (Vitis sp.) Yellow Poplar (Liriodendron tulipifera)

at any time after the survey. Thus, if more definitive information is desired about a particular area, sequential surveys would be necessary in the same area throughout the growing season.

The basic technique of conducting a roadside survey is valid. This method, perfected by TVA specialists (personal communication) provides coverage adequate to identify affected species and delineate the acreage involved. As a method utilized by forest pathologists, it has its greatest application in cases of recurring fumigations. In these instances, injury to affected forest species could be plotted with respect to increasing severity of symptoms, area enlargement, and host tree mortality.

LITERATURE CITED

Jacobson, J. S. and A. C. Hill. 1970. Recognition of Air Pollution Injury to Vegetation: A Pictorial Atlas. Air Pollution Control Association, Pittsburgh, Pa.